TDP1-TESTBED APPLICATIONS:

PACKET-LEVEL-CODED DATA TRANSMISSION VERIFICATION THROUGH ATMOSPHERE VIA OPTICAL SATELLITE-TO-GROUND-LINKS

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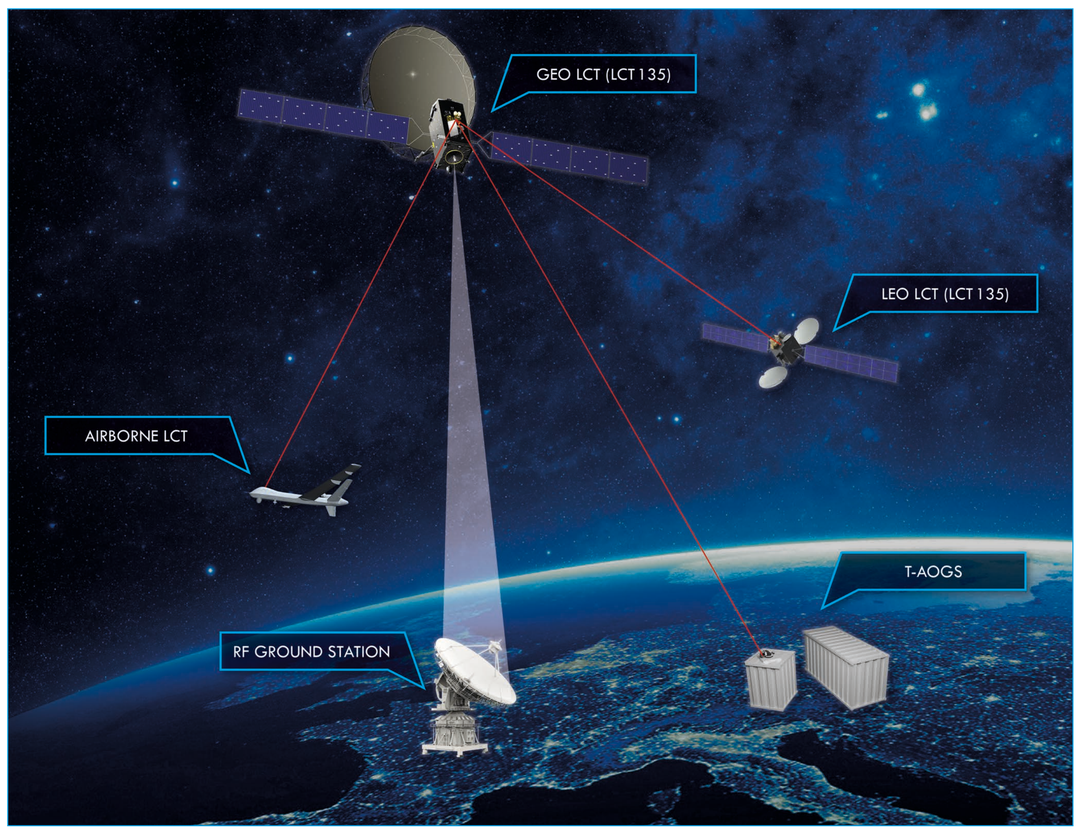
Optical communication combines the benefits of unregulated frequencies and high capacity as well as point-to-point data transmission. Currently there are commercial applications like the European Data Relay Satellite System (EDRS) for optical Inter-Satellite Links (ISLs). With the application of Packet-Level-Coding (PLC) within Satellite-to-Ground Links (SGLs) it is feasible that the same order of ISL-Bit Error Rate can be achieved, which makes optical links through atmosphere also suitable for commercial applications.

The Technology Demonstration Payload No.1 (TDP1) testbed is an excellent platform for supporting optical high-data-rate communication through atmosphere. The system consists of the Transportable Adaptive Optical Ground Station (T-AOGS), currently located in Tenerife (Spain), a Laser Communication Terminal (TDP1-LCT), a Ka-Band payload for downlink on board of Alphasat and the complementary RF-Ground segment (Remote Sensing Data Center in Oberpfaffenhofen, Germany) for the data- and telemetry-reception of the LCT via the TDP1-Ka-Band-Downlink.

New technology applications can be demonstrated and validated using this test system. During the last four years TESAT carried out more than 1100 SGLs between the T-AOGS and the TDP1-LCT. The links were executed in different seasons during the years and under different atmospheric conditions with various experimental aspects. The TDP1-LCT is a system with 1064 nm and BPSK-coding. The T-AOGS performs links beacon-less and with a master-slave method.

TDP1 – TESTBED COMPONENTS



TESTBED APPLICATION:

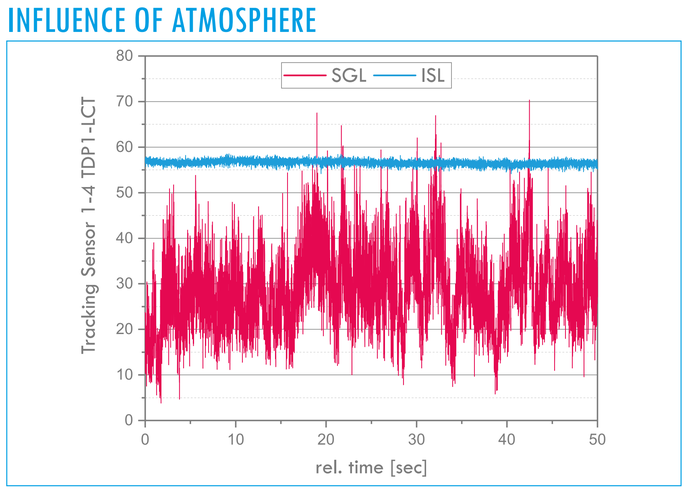
- Possibility for 25 kHz LCT telemetry, e.g. for research of receive signal on TDP1-LCT
- TDP1 commanded & T-AOGS operated by TESAT (full control of the T-AOGS); different parameters can be applied, new devices can be connected and tested
- TDP1/T-AOGS optical link can be used by 3rd party on ground, different steps of acquisition can be tested consecutively
- New ground stations or LCTs can be tested within testbed

SYSTEM PARAMETER SPACE / GROUND SEGMENT:

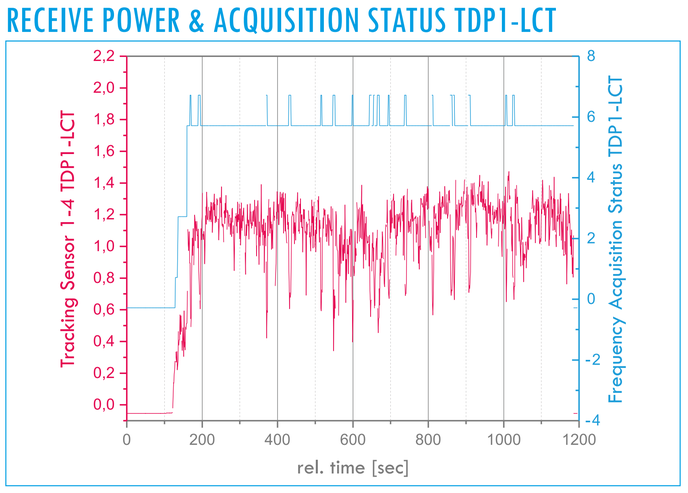
ITEM	T-AOGS	LCT ON ALPHASAT
User Data Rate	1.8 Gbps	1.8 Gbps
Range	38,000 km	38,000 km
Transmit Power	Up to 50 W	5 W
Transmit Beam Diameter and 3 dB divergence angle (half cone)	20 mm - 33.9 µrad 35 mm - 19.4 µrad 48 mm - 14 µrad 95 mm - 7.1 µrad	135 mm - 5.0 µrad
Receive Beam Diameter	270 mm	135 mm
Dual channel (one transparent, one for downlink)	0.7 nW/cm² = 7µW/m² (for BER 10^{-5} @ 2.8125Gbps ~ BER 10^{-8} @ 1.8 Gbps)	28 nW/cm² = 280 µW/m² (for BER 10^{-5} @2.8125Gbps ~ BER 10^{-8} @ 1.8 Gbps)

TDP1 – TESTBED EXAMPLE

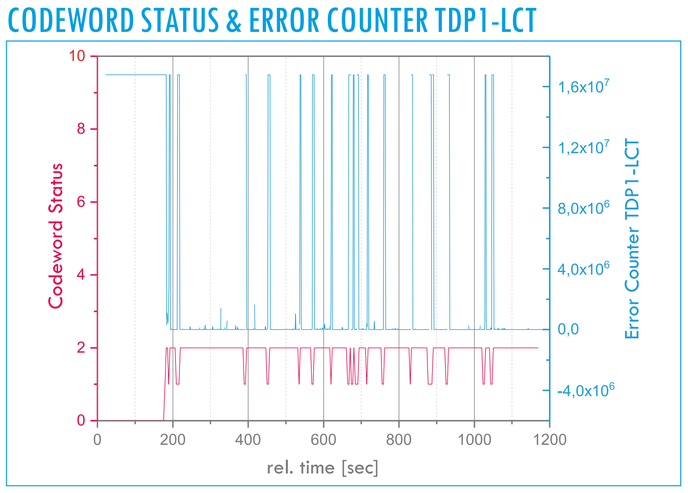
INFLUENCE OF ATMOSPHERE



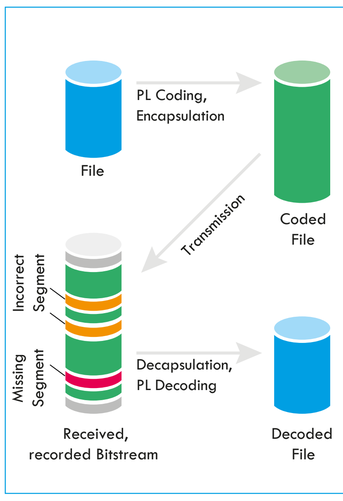
RECEIVE POWER & ACQUISITION STATUS TDP1-LCT



CODEWORD STATUS & ERROR COUNTER TDP1-LCT

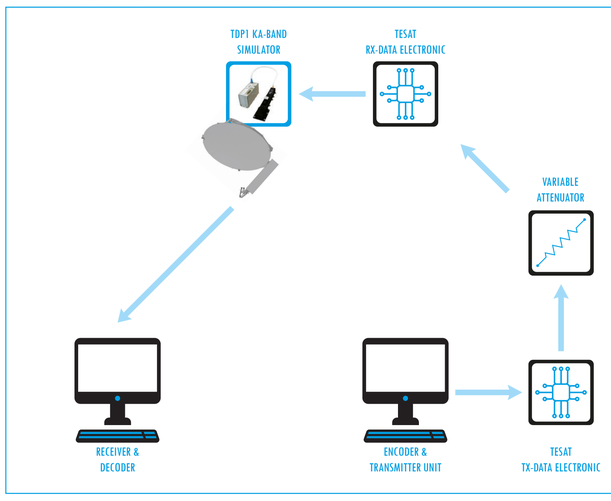


CONCEPT OF CODING

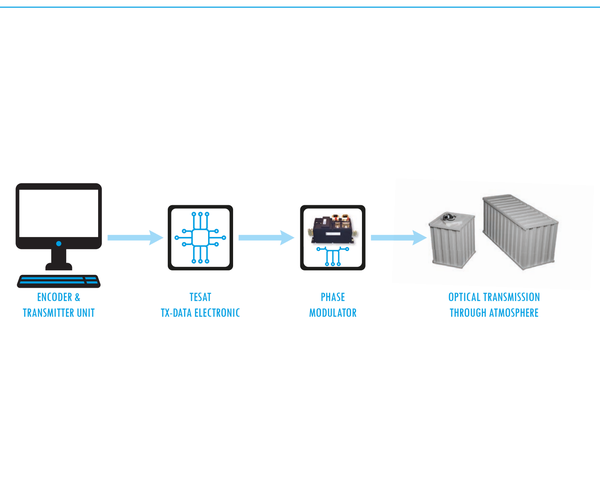


- Packet-Level-Coding designed for optical near-earth and deep space communications
- Goal: improve bit error rate of the user data
- Disturbance of the optical link and the data transmission due to atmospheric perturbations
- These fading effects can be analysed before the design of the customized Packet-Level-Coding

ON-GROUND VERIFICATION



IN-ORBIT VERIFICATION



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